THE MACT PROCESS -- AND THE INDUSTRIAL BOILER & UTILITY INDUSTRY SECTORS

Wisconsin Department of Natural Resources

Mercury Citizen's Advisory Committee

Madison, Wisconsin

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Presentation Outline

- Overview of section 112 of the Clean Air Act
- Outline the MACT development process
- Utility MACT development and schedule
- Industrial Boiler MACT development and schedule
- Possible mercury controls

Section 112 - General

- Contains list of 188 hazardous air pollutants (HAP)
- Requires EPA to publish a list of major sources that emit HAP
- Requires EPA to establish emission standards (NESHAP) for each category of major sources
- Allows EPA to establish work practice requirements
- MACT standards must include compliance date no later than 3 years after promulgation

Section 112 - MACT

- Mandates that EPA develop standards for HAP
- Standards are based on the use of maximum achievable control technology (MACT)
- Sets minimum stringency criteria (MACT floor)
- MACT may differ for new and existing sources
- Allows for subcategorization

Format of Section 112 Rule

- Emissions standard applicable to each source
- Trading not allowed in any consideration of the level(s) of control at the floor
  - Trading among units at given facility allowed

Major Source

- ".. Any stationary source or group of stationary sources located within a contiguous area and under common control that emits or has the potential to emit considering controls, in aggregate, 10 tons per year or more of any hazardous air pollutant or 25 tons per year or more of any combination of hazardous air pollutants..."

MACT Development Process

- Conduct an industry study
- Establish MACT floor/subcategories
- Develop control options
- Assess impacts of options
- Propose standards
- Receive public comments
- Respond to comments
- Promulgate final standards

MACT Floor

- For existing sources
  - "The average emission limitation achieved by the best performing 12 percent of existing sources..."
- For new sources
  - "The emission control achieved in practice by the best controlled similar source..."
- Recent court decisions will be examined for impact on how floors are established

Utility MACT

Background -- Mandate

- Section 112(n)(1)(A) of Clean Air Act (CAA): EPA must perform study of, and report to Congress on, the hazards to the public health of HAP emissions from fossil fuel-fired electric utility steam generating units
- Based on the results of the study, Administrator must determine whether HAP regulations for such units are necessary and appropriate

Background -- Study

- Report to Congress issued in February 1998
  - HAP of greatest concern -- mercury from coal-fired units
  - Some concern from other HAP from coal-fired units and from oil-fired units

Background -- ICR

- Information collection request
  - Intended to inform electric utility regulatory determination along with health studies (e.g., National Academy of Sciences report), control option analyses, etc.
  - Intended to improve overall estimate of the amount and species of mercury being emitted from coal-fired utility units

Background -- ICR (conc.)

- Identified all coal-fired units meeting CAA definition and their control configuration
- Required all coal-fired units to analyze coal mercury content during calendar year 1999
- Required ~85 coal-fired units to test for speciated mercury emissions

Background -- Determination

- EPA announced finding on 12/14/2000
  - Regulation necessary for oil- and coal-fired boilers
  - Regulation not necessary for gas-fired boilers
  - Based on
    - Public health concerns
    - Mercury emissions from power plants
    - Information that mercury from power plants can be controlled

Section 112 Focus

- Most of attention has been on mercury from coal-fired units
- Also concerned about
  - Other HAP from coal-fired units
  - Nickel from oil-fired units
- Listing decision triggers section 112(g) case-by-case MACT determinations for new coal- and oil-fired sources

MACT Process

- Clean Air Act Advisory Committee Working Group
  - Representatives of industry, environmental groups, State/Local/Tribal organizations
  - Sally Shaver, EPA, and John Paul, Dayton Regional Air Pollution Control Agency, Co-Chairs
  - Bimonthly meetings for approximately 1 year
    - Meetings held August, November, December 2001; February 2002
    - Next meeting -- March 4/5 in Washington, D.C.
  - Information to be provided on website
  - Outreach and stakeholder communication

MACT Activities

- Continuing ICR data analyses for the purpose of establishing section 112 MACT standards
  - Potential subcategories
    - Boiler type
    - Coal type
    - Control device type
    - Other -?
  - Floor determination
  - Best performing technology ("new source" MACT)
  - Adequacy of data

Coordination Activities

- Coordination with ORD, DOE, EPRI, UNDEERC, etc. on current mercury control research
  - More testing on existing control devices and enhancements
  - More testing on SCR/SNCR installations
  - Coal combustion residue issues
  - Control device cost analyses
  - Hg CEM activities
    - Long-term demonstrations on 1-2 units
    - Short-term demonstrations on multiple units

Ongoing Research Areas

- DOE field test program
  - PowerSpan - multi-pollutant removal system
  - ADA - ESP retrofit (4 sites)
    - Alabama Power E.C. Gaston - completed
    - Wisconsin Electric Pleasant Prairie - completed
  - B&W - wet scrubber reagent (Endicott, Zimmer)
  - UNDEERC - hybrid electrified FF w/activated carbon
  - Apogee - ESP tests w/sorbent injection (2-3 sites)
  - CONSOL - cooling system w/calcium sorbents
  - Southern Co. - multipollutant sorbents
  - USR Radian - oxidation catalysts
- Also research on impact of SCR/SNCR

DOE Program Information

- Further information on the DOE program may be found on the following websites
  - http://www.fe.doe.gov/coal_power/existingplants/index.shtml
  - http://www.fe.doe.gov/coal_power/existingplants/mercurycontrol_fs.shtml
  - http://www.fe.doe.gov/techline/tl_mercurycontrol_1.html
- Additional information, including technical papers, are available on the linked company webpages

Additional Activities

- More sophisticated deposition analyses using REMSAD and new mercury emissions data
- Analyses using IPM looking at the costs and market impacts of a variety of potential levels of mercury control

Timing

- Settlement agreement provides for
  - Proposal of section 112 regulations by 12/15/2003
  - Promulgation of section 112 regulations by 12/15/2004
- Compliance date of 12/15/2007

Website

- Utility MACT information located at:
  - www.epa.gov/ttn/atw/combust/utiltox/utoxpg.html
    - Announcements of new postings, upcoming activities
    - Background material
    - Coal data for 1999
    - List of plants
    - Speciated mercury emission test reports
    - Summary analyses of speciated emission data

Utility MACT Contact

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Industrial Boiler MACT

Status of Industrial Boiler MACT

- Source categories included:
  - Industrial boilers
  - Institutional/commercial boilers
  - Process heaters
- Major source MACT only
- Subcategorizing by fuel type, size, and use

What is a Process Heater?

- An enclosed device using controlled flame and the unit's primary purpose is to transfer heat indirectly to a process material, instead of generating steam
- Process heaters are devices in which the combustion gases do not directly come into contact with process gases in the combustion chamber

Industrial Boilers Plus Process Heaters?

- Boilers and "indirect-fired" process heaters are similar combustion devices
  - Combust similar fuels to heat water (steam) or other materials
  - Both transfer heat indirectly
  - Fuel-related emissions are the same

Potential Affected Existing Sources

- Total: 57,000 units (42,000 boilers, 15,000 process heaters)
  - 2,500 coal-fired units
  - 46,800 gas-fired units
  - 700 wood-fired units
  - 6,000 oil-fired units
  - 1,200 mixed fuel-fired units
- Based on size or co-location

Projected Affected New Sources

- Based on DOE fuel consumption forecasts
- Based on existing population data
- Total: 4,500 boilers (fifth year)
  - 250 coal-fired boilers
  - 100 wood-fired boilers
  - 260 oil-fired boilers
  - 3,900 gas-fired boilers

Emission Controls

- Various controls and combination are used
- Metals and particulate matter
  - Fabric filters, ESP, scrubbers
- Acid gases (HCl)
  - Scrubbers (wet or dry)
- Mercury
  - Fabric filters
- Organic HAP (dioxins, formaldehyde)
  - CO monitoring and limit

Databases

- Inventory database (fossil fuel)
- Survey database (nonfossil fuel)
- Emission database
- Can be downloaded from EPA's website at:
  - www.epa.gov/ttn/atw/combust/iccrarch/iccrarch.html
  - Microsoft ACCESS is the database software

What Units Will the MACT Cover?

- All industrial boilers located at major sources
- All commercial and institutional boilers located at major sources
- All process heaters located at major sources

What Units Will the MACT Not Cover?

- Fossil fuel-fired electric utility boilers
- Boilers burning municipal waste
- Boilers burning hazardous waste
- Boilers burning medical waste
- Black liquor recovery boilers
- Hot water heaters
- Waste heat boilers

Preliminary Baseline Emissions

- HCl = 66,000 tpy
- Lead = 175 tpy
- Chromium = 200 tpy
- PAH = 580 tpy
- Formaldehyde = 3,850 tpy
- Mercury = 14 tpy
- Particulate Matter = 1,000,000 tpy

Preliminary Subcategories

- Main subcategories selected based on fuel type
  - Solid, liquid, gaseous fuel-fired units
- Subcategories to analyze impacts on small businesses
  - Subcategories based on size
    - Large (greater than 10 MMBtu/hr heat input)
    - Small (less than 10 MMBtu/hr heat input)
  - Subcategories based on use
    - Limited-use (less than 10% capacity factor)
- Total of 9 subcategories

MACT Floor - Existing Units

- Preliminary MACT floors based on control technologies for existing sources
  - For solid fuel boilers
    - Large units -- Baghouse (metals)/scrubber (HCl)
    - Small units -- No demonstrated emission reduction
    - Limited-use units -- ESP
  - For liquid fuel units -- No demonstrated emission reduction
  - For gaseous fuel units -- No demonstrated emission reduction
- MACT floors are actually emissions levels

MACT Floor - New Units

- Based on control technologies, State regulations, and new source performance standards (NSPS)
- Solid fuel units
  - Large units -- Baghouse/scrubber/CO limit
  - Small units -- Baghouse/scrubber
  - Limited-use Units -- Baghouse/scrubber/CO limit

MACT Floor - New Units (more)

- Liquid fuel units
  - Large units -- Baghouse/scrubber/CO limit
  - Small units -- Baghouse/scrubber
  - Limited-use units -- Baghouse/scrubber/CO limit
- Gaseous fuel units
  - Large/limited use units -- CO limit
  - Small units -- No demonstrated emission reduction
- MACT floors are actually emissions levels

Preliminary MACT Floor Levels

- Based on review of emission database
- Existing large solid fuel-fired units
  - PM -- about 0.065 lb/MMBtu
  - HCl -- about 0.048 lb/MMBtu (45 to 50 ppm)
  - Hg -- ?
- New large solid fuel-fired units
  - PM -- about 0.04 lb/MMBtu
  - HCl -- about 0.016 lb/MMBtu (15 to 20 ppm)
  - CO -- 200 ppm @ 3% oxygen
  - Hg -- ?

Beyond the Floor Control Options

- For solid fuel boilers -- fuel switching (Hg)/CO limit
- For liquid fuel boilers -- ESP (metals)/CO
- For gaseous fuel boilers -- CO limit

Provisions Being Considered

- Alternate metal standard
  - Minimize impacts on small businesses
  - Sensitive to sources burning fuel with little metals, but emitting PM which would require control
  - Sum of 8 selected metals: arsenic, beryllium, cadmium, chromium, lead, manganese, nickel, and selenium
  - Will be based on review of emission database
    - About 0.001 lb/MMBtu

Issues

- Court opinion from National Lime Association litigation on the Cement Kiln MACT
  - Opinion was that material substitution (pollution prevention [i.e., fuel switching]) should be considered in the MACT floor analysis
  - Fuel switching is not considered an appropriate MACT floor technology for industrial boilers because
    - Uncertain benefits
      - Decrease in some HAP (metals, HCl)
      - Increase in some HAP (organic HAP)
    - Potentially lower efficiency
    - Fuel availability concerns

Schedule

- Proposal Summer 2002
- Promulgation Summer 2003
- Compliance date Summer 2007

Information

- Information on the MACT rulemaking for industrial, commercial, and institutional boilers and process heaters is available at:
  - www.epa.gov/ttn/atw/combust/boiler/boilerpg.html

Industrial Boiler MACT Contact

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Possible Mercury Controls

Mercury Capture

- Hg(p) easily captured by ESP and FF units
- Hg^{2+} exhibits high to low solubility and can generally be captured in scrubbers
- Hg° is insoluble; must be adsorbed on to solids or converted to Hg^{2+} for capture by scrubbing
- Hg^{2+} is generally easier to adsorb than Hg°
- Adsorption highly dependent on flue gas composition and temperature
- Typical Hg^{2+}:Hg° in flue gas: bituminous coal > subbituminous coal > lignite

Major Conclusions of Determination Studies

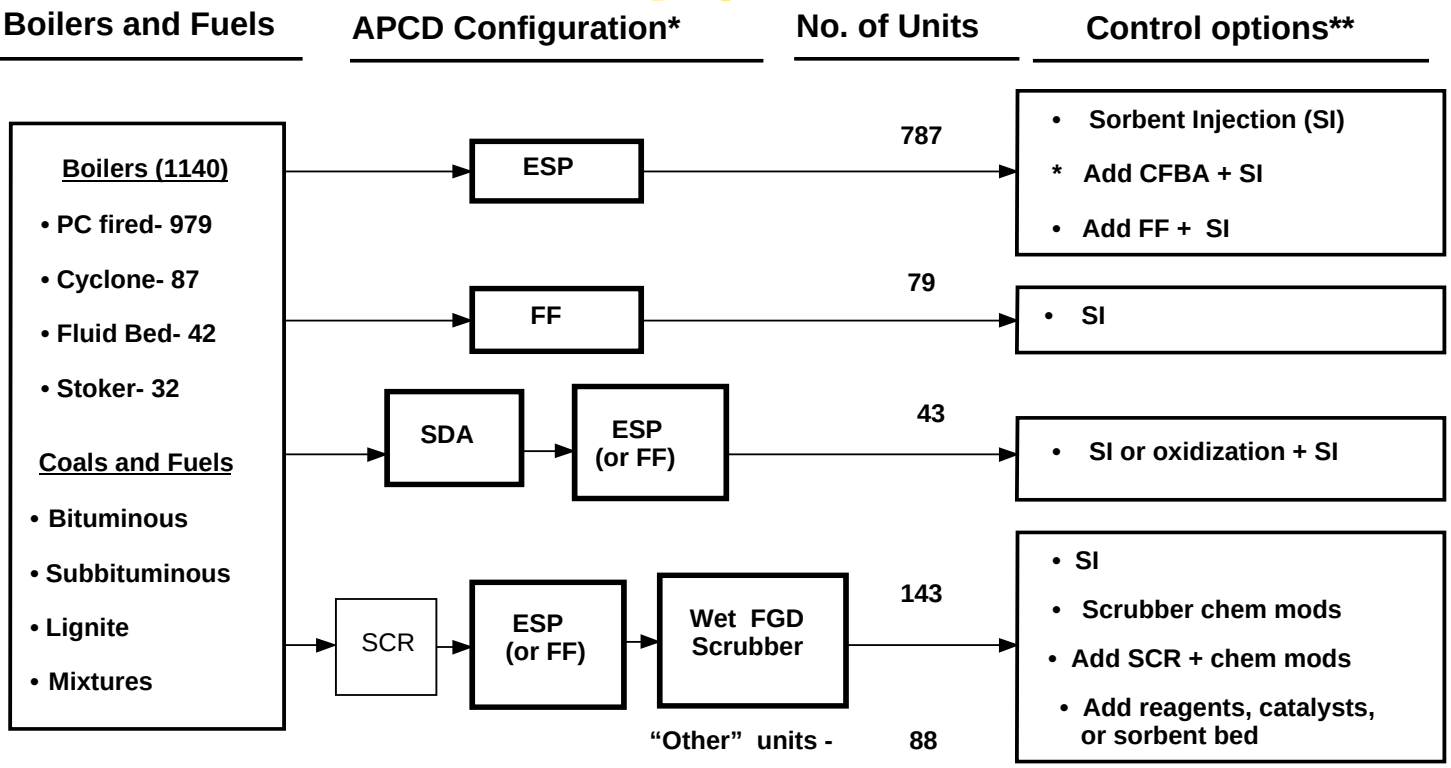
- 48 tons of Hg emitted from coal-fired units in 1999
- Capture by existing equipment ranges from 0 to >90%
- Moderate to good capture for bituminous
- Poor capture for subbituminous and lignite
- Best capture for dry and wet FGD scrubbers
- Capture associated with PM controls:
  FF > ESPs > PM scrubbers & mechanical collectors
- NOx controls (particularly SCR/SNCR) may enhance ability to capture Hg

Mean Mercury Emission Reductions for Existing PC-Fired Units[a], %

Add-on Controls	Type of Coal		
	Bituminous	Subbituminous	Lignite
PM Only			
CS-ESP	29	3	3
HS-ESP	11	0	NT
CS-FF	89	73	NT
PM Scrubber	12	0	33
Dry FGD Scrubbers			
SDA+ESP	45	0	NT
SDA+FF	93	23	17
Wet FGD Scrubbers			
CS-ESP+Wet FGD	78	16	42
HS-ESP+Wet FGD	39	8	NT
CS-FF+Wet FGD	97	NT	NT

a. Based on OH train data. NT= not tested.

Mercury Control Retrofit Options



* ESP= electrostatic precipitator, FF=fabric filter, CFBA=circulating fluidized-bed absorber, SCR=selective catalytic reduction (6 units), SDA=Spray dry adsorber

** Selected control options--other options possible. Flue gas cooling and additional ducting may be used with sorbent injection (SI)

Estimated Feasible Levels of Near- and Long-Term Control*

PERCENT REDUCTION FROM INLET CONCENTRATION

Existing	Current		Near-Term	
Technology	Bit	Sub	Bit	Sub
ESP	29	3	70	45
FF	89	73	90	85
SDA + ESP	45		80	70
SDA + FF	93	23	90	80
ESP + wet FGD	78	0	90	50
FF + Wet FGD	97		90	85

Long-term control ranges from 85 to 95 % depending on coal and control technologies

* Mercury control for pulverized coal-fired boilers and units with cold-side ESPs or FFs. Current control from ICR data; Near-term control (2007-2008) is based on use of PAC.

The Future -- Activated Carbon

- Existing DOE program yielding results on what may be possible in the near- to long-term
  - Activated carbon injection tests conducted on two facilities to date
    - Alabama Power E.C. Gaston - low sulfur bituminous coal w/hot-side ESP and COHPAC unit
    - Wisconsin Electric Pleasant Prairie - subbituminous coal w/cold-side ESP
  - Two additional facilities to be tested
    - PG&E NEG Salem Harbor - low sulfur bituminous coal w/cold-side ESP and SNCR
    - PG&E NEG Brayton Point - low sulfur bituminous coal w/cold-side ESP and carbon/ash separation

The Future -- SCR/SNCR

- Tests conducted at seven units
  - Four with SCR
    - One subbituminous coal-fired
    - Three bituminous coal-fired
  - One with SNCR
    - Bituminous coal-fired
  - Two with ammonia injection
    - One subbituminous coal-fired
    - One bituminous-subbituminous coal blend

The Results -- Activated Carbon

- E.C. Gaston tests indicated that mercury removals as high as 90% were achieved on the bituminous coal
- Pleasant Prairie tests indicated that mercury removals as high as 70% were achieved on the subbituminous coal but at a higher "cost" than was observed for 40-60% mercury removal
  - Impacts on potential to sell fly ash
  - Higher mercury removals greatly increased use of activated carbon and cost

The Results -- SCR/SNCR

- Preliminary results
  - Oxidation of mercury enhanced with SCR use on two of the bituminous coals
  - No significant mercury oxidation enhancement with SCR use on one bituminous coal or the subbituminous coal
  - Ammonia injection and SNCR did not appear to enhance mercury oxidation

What More Could be Done?

- Further tests are yet to be conducted that will address some of the issues
- Modifications that could be considered to lower costs, preserve fly ash value, etc.
  - Use of COHPAC unit for activated carbon injection as done at E.C. Gaston - preserves fly ash in ESP
  - Use of ash/carbon separation techniques as will be investigated at Brayton Point - preserves both
  - Activated carbon modifications to make it more "mercury friendly" - more "reactive" sorbent

And...

- More work yet to be done
  - Different coal types
  - Different control configurations
  - Applications to other processes (e.g., industrial boilers)
  - Different catalysts and catalyst system designs
- There are some promising signs